

6.6 Design Frequency

6.6.1 Overview

Since it is not economically feasible to design a structure for the maximum runoff a watershed is capable of producing, a design frequency must be established. The frequency with which a given flood can be expected to occur is the reciprocal of the probability or chance that the flood will be equaled or exceeded in a given year. If a flood has a 20 percent chance of being equaled or exceeded each year, over a long period of time, the flood will be equaled or exceeded on an average of once every five years. This is called the return period or recurrence interval (RI). Thus the exceedence probability equals $100/RI$.

The engineer must recognize that flood discharges for larger watercourses and rivers where the 100 year frequency must be used are the result of statistical analysis. When considering the 100 year flood discharges, for example, it is often misconstrued as a flood which happens once in a hundred years. In reality, it has a one percent chance of occurring in any one year. However, it can occur several times in any one year, as it did in Connecticut during 1955 and the midwest in 1993. The 100 year flood can occur more than once during a 100 year period as is evident in Connecticut where the floods of 1938, 1955, 1982 and 1984 all exceeded the 100 year flood in some areas of the state. As future flood data is evaluated it can change the statistical discharge when added to the statistical analysis dependent on the length of records considered. This usually will result in increasing the discharge. However, discharges can also be decreased if flood control structures are implemented as is the case on the Connecticut, Quinebaug, Shetucket, Naugatuck and other rivers.

6.6.2 Frequency Table

Appendix A presents design frequencies to be used by the Department for the various drainage/hydraulic facilities.

6.6.3 Rainfall vs. Flood Frequency

Drainage systems and structures are designed based on a chosen flood frequency. However, certain hydrologic procedures use rainfall and rainfall frequency as the basic input. Thus it is commonly assumed that the 10-year rainfall will produce the 10-year flood. Depending on antecedent soil moisture conditions, and other hydrologic parameters, there may or may not be a direct relationship between rainfall and flood frequency.

6.6.4 Rainfall Curves

Rainfall data are available for many geographic areas. From these data, rainfall intensity-duration curves have been developed for the commonly used design frequencies. Appendix B at the end of this chapter contains the table recommended for use. Additionally, total rainfall-duration-frequency relationships are presented for use with hydrologic models. (Table B-1)

6.6.5 Discharge Determination

Estimating peak discharges of various recurrence intervals is one of the most common engineering challenges faced by drainage facility designers. The problem can be divided into two general categories:

- Gaged sites - the site is at or near a gaging station and the streamflow record is of sufficient length to be used to provide statistical estimates of peak discharges.
- Ungaged sites - the site is not near a gaging station and no streamflow record is available.

This chapter will address hydrologic procedures that can be used for both categories.